

# Monitoring Changes in Land Cover with Remote Sensing: Some Relevant Concepts and Examples

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Zhiqiang Yang\*

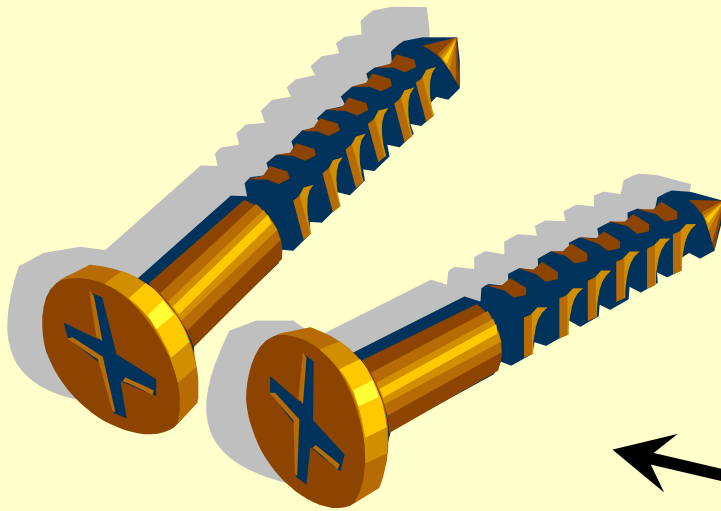
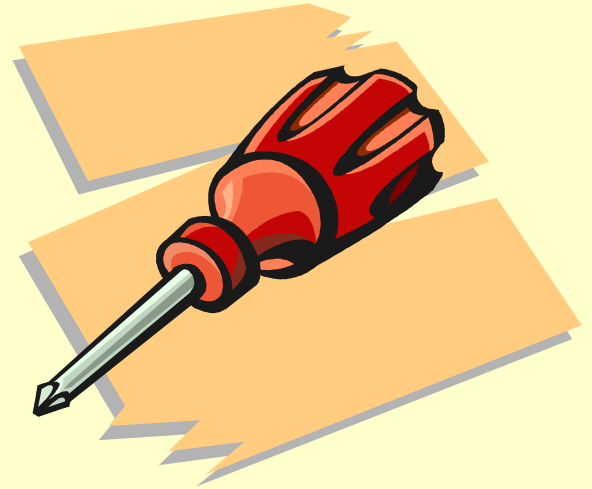
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Corvallis, OR

# Monitoring Changes in Land Cover with Remote Sensing: Some Relevant Concepts and Examples

- Matching needs with tools
- Data space and transformations
- Reference data and sampling
- A few examples from the North Coast and Cascades Network of NPS and environs

# Two general approaches used in remote sensing:

Problem → tool



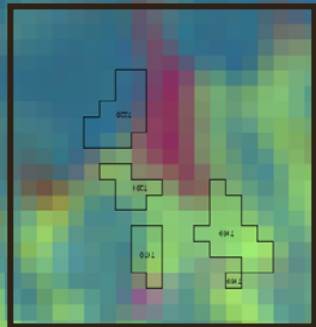
Tool → problem



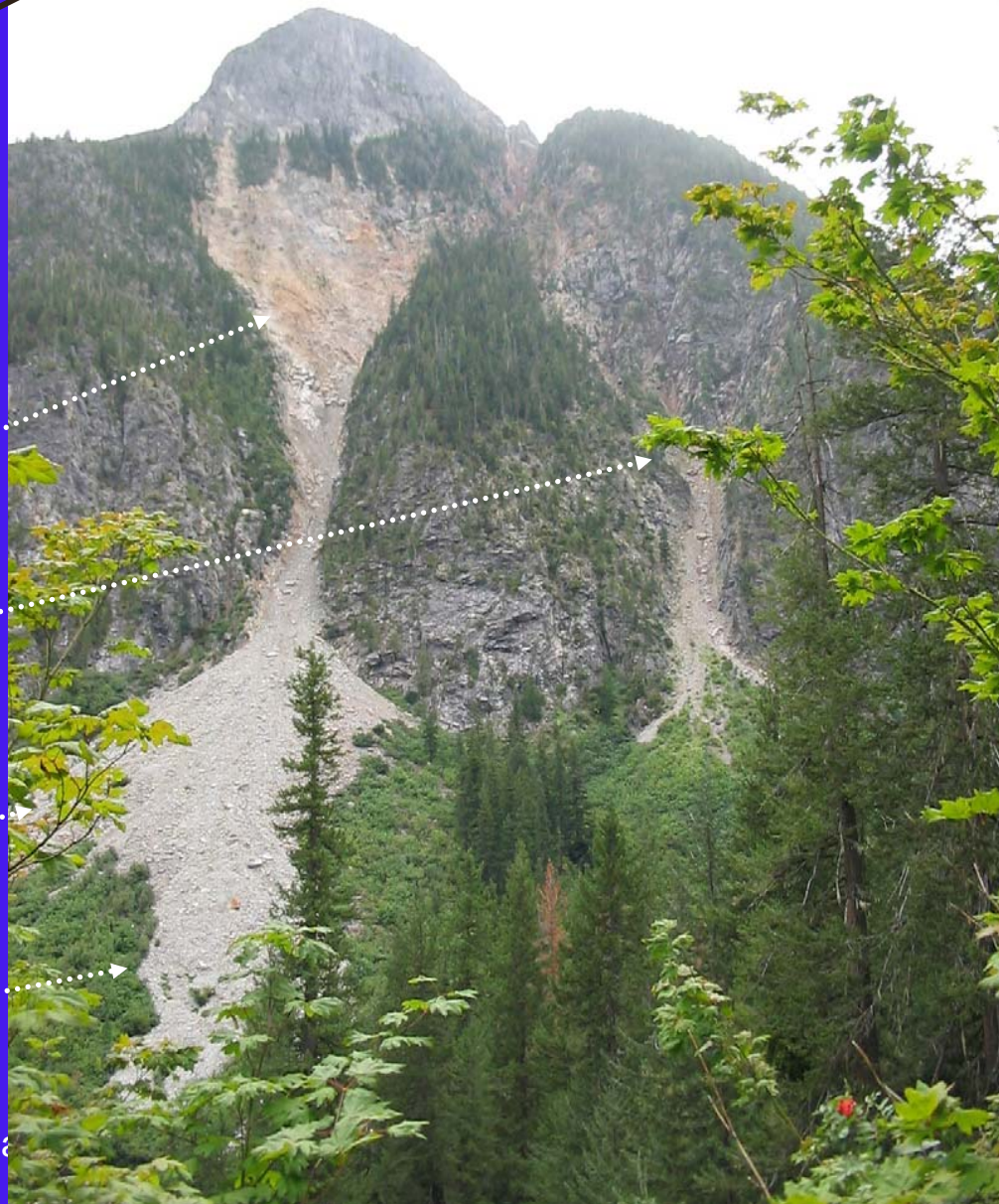
# Landslide (NOCA-Flat Creek-7170,7169,7220,7276,7279)

14aug2002 tasseled cap

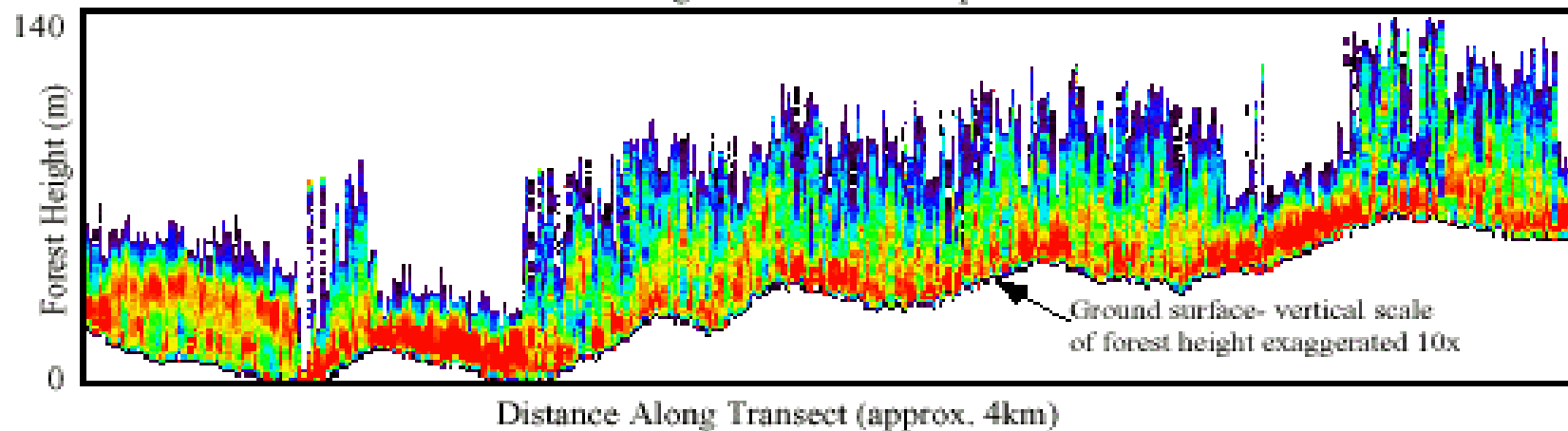
500 m MODIS pixel



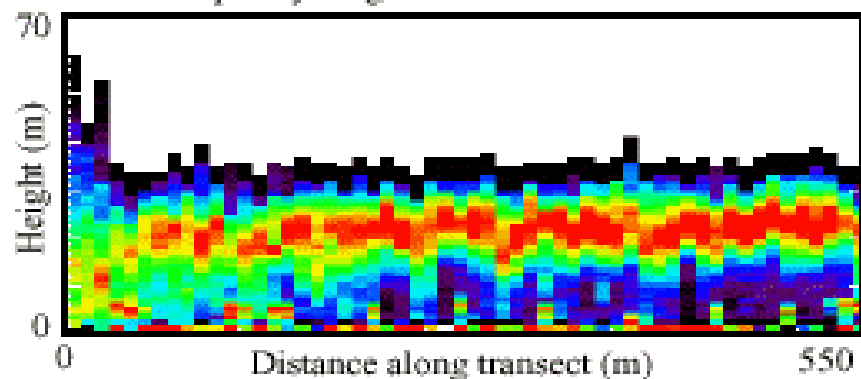
26jul2004 tasseled cap



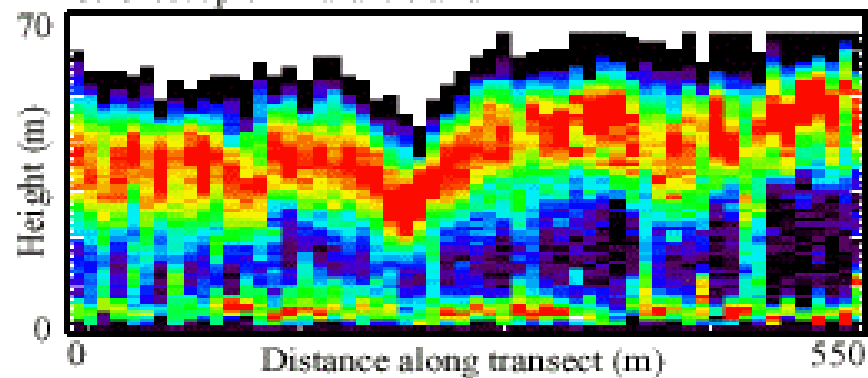
A. View of a SLICER lidar transect through H.J. Andrews Experimental Forest



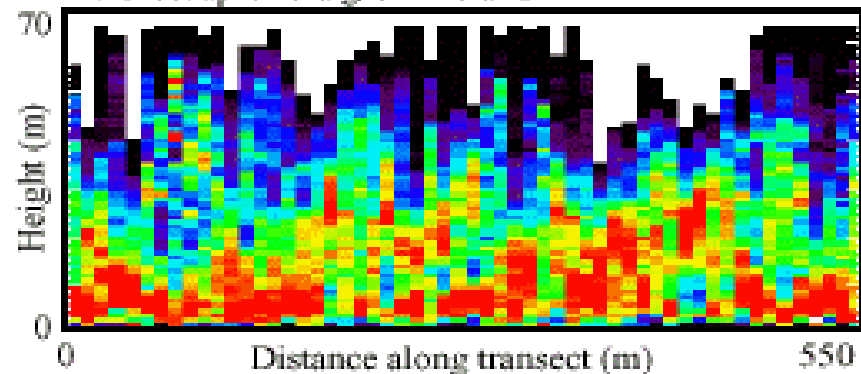
B. Closeup of young stand



C. Closeup of mature stand



D. Closeup of old growth stand



High Canopy Density

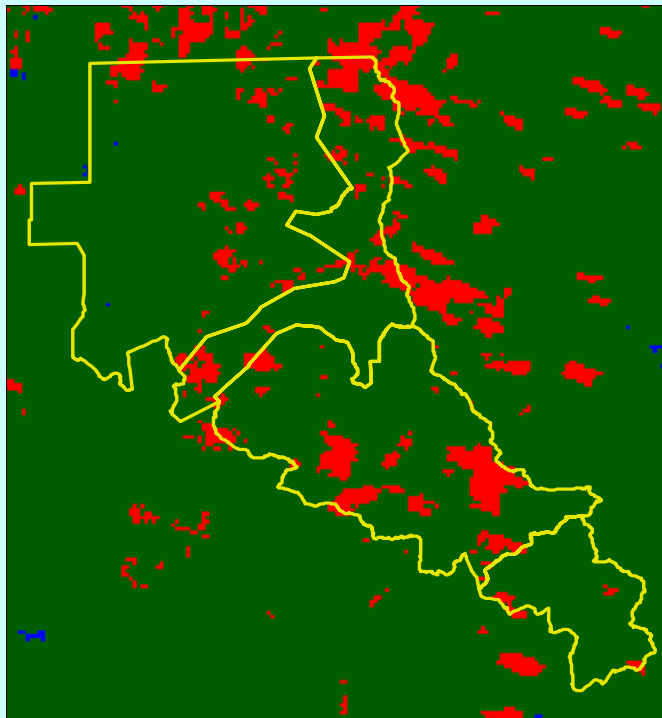
Low Canopy Density



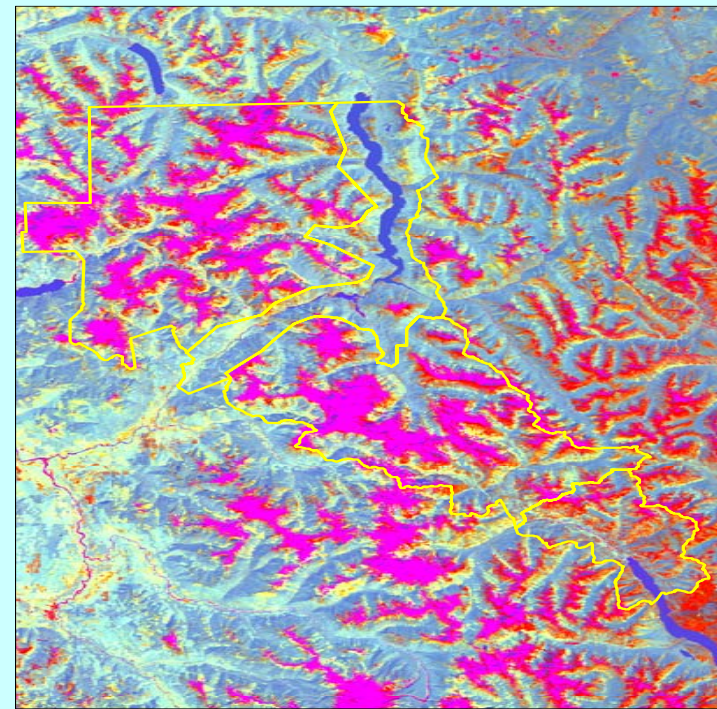
But, for monitoring, currently multi-temporal lidar is hard to come by

Bottom line...

- Best tool not always available, but adequate tool may be
- Choose wisely

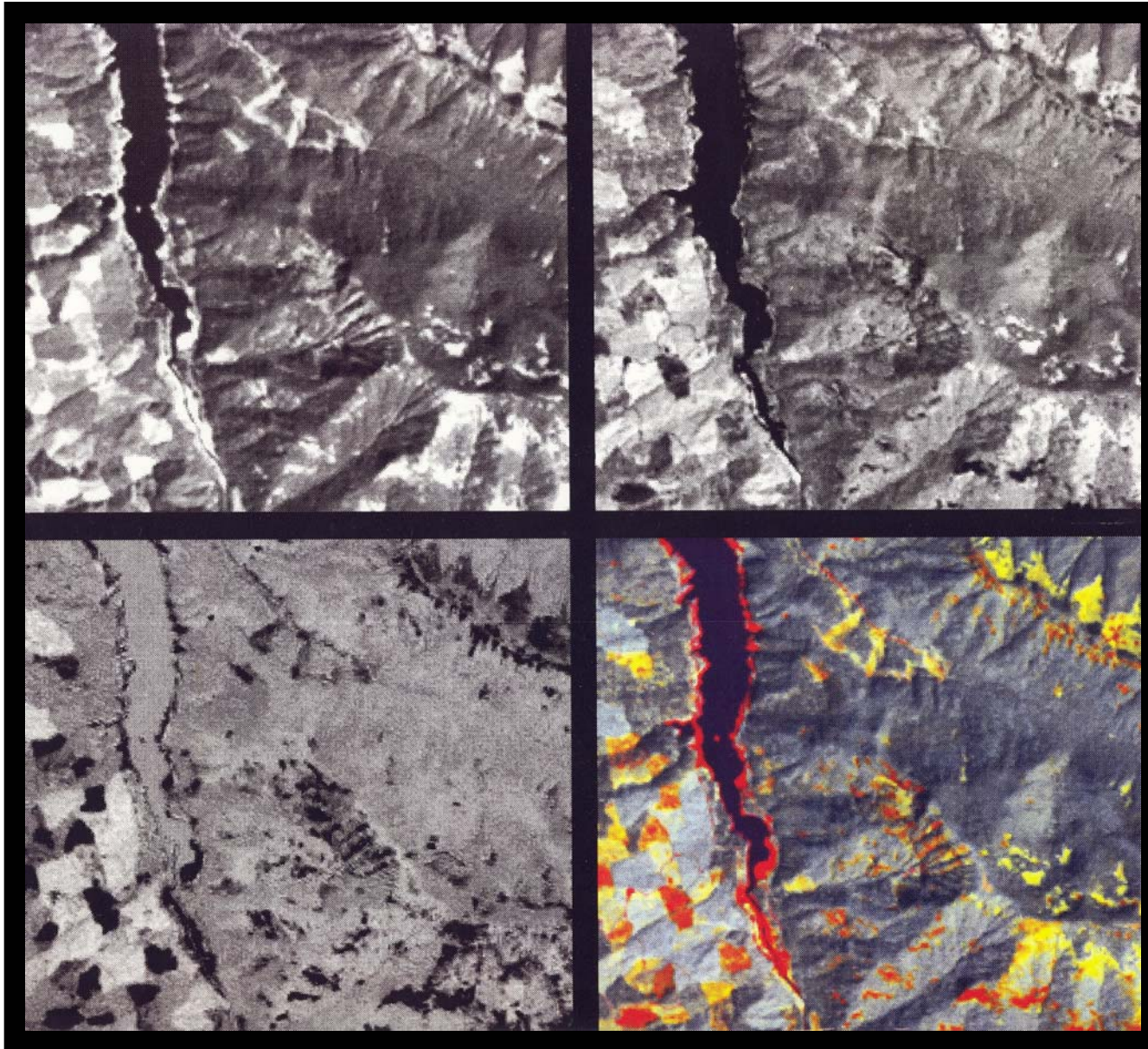


MODIS snow product



MODIS Tasseled Cap

# Information in the Spectral Domain

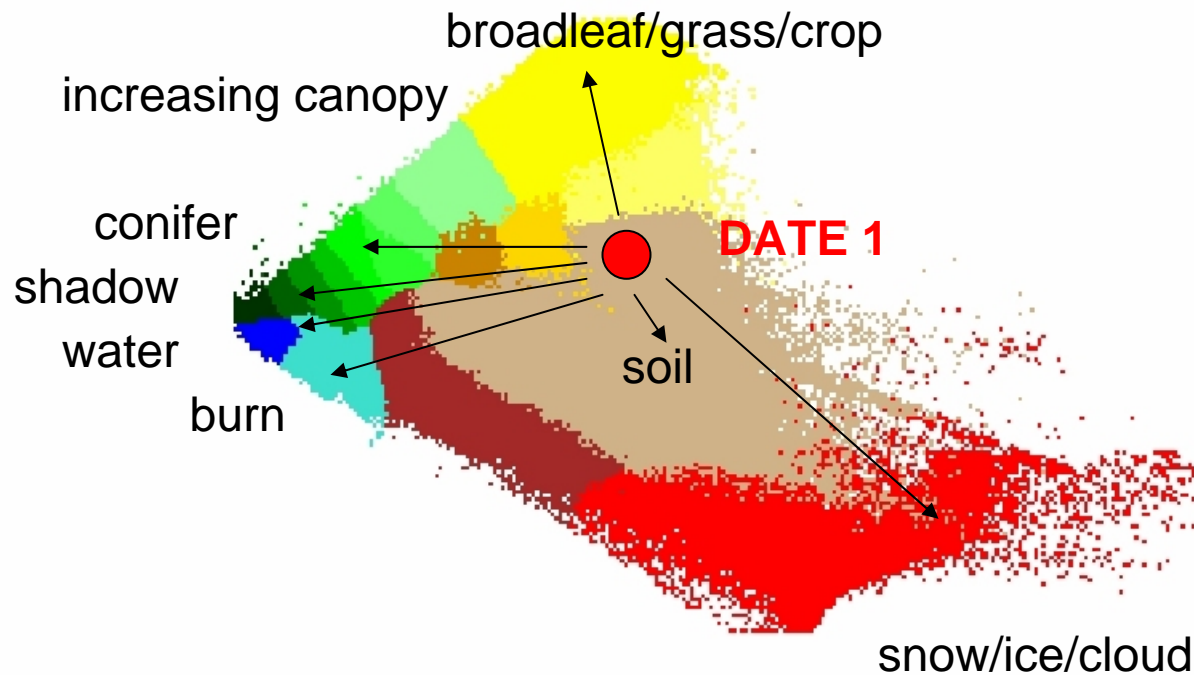


$n$ -space  
indices,  
e.g.,  
Tasseled  
Cap: b,g,w

If you have  
SWIR→  
Exploit it!



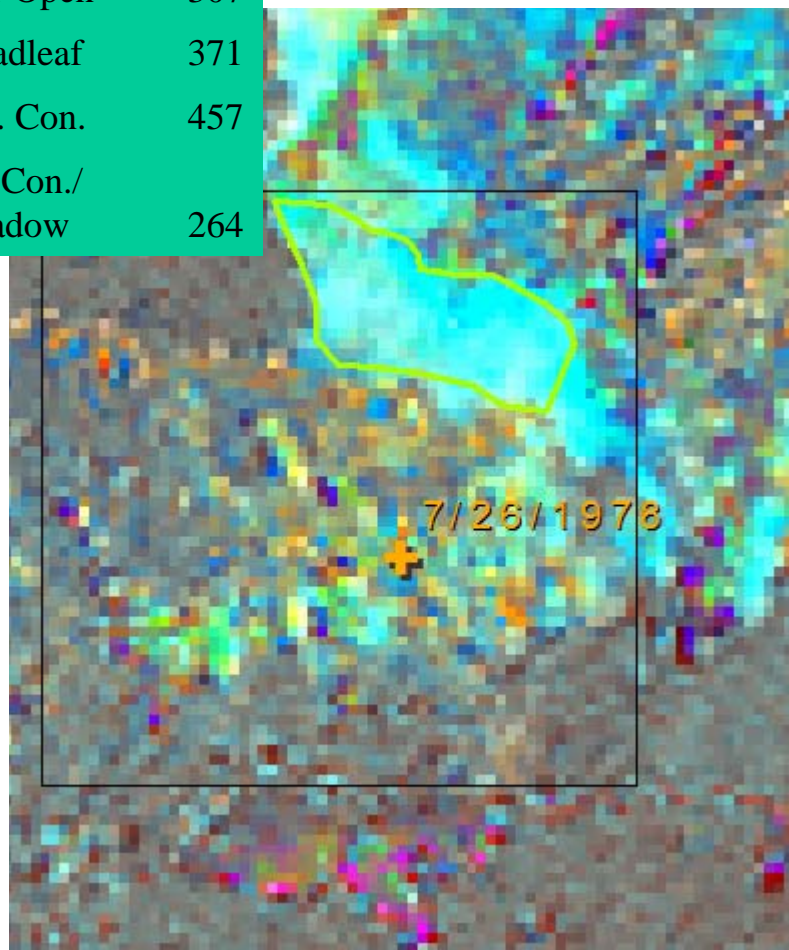
With adequate tool and transformation,  
monitoring cover changes can be accomplished  
by monitoring changes in the data space...





## Vector Scores

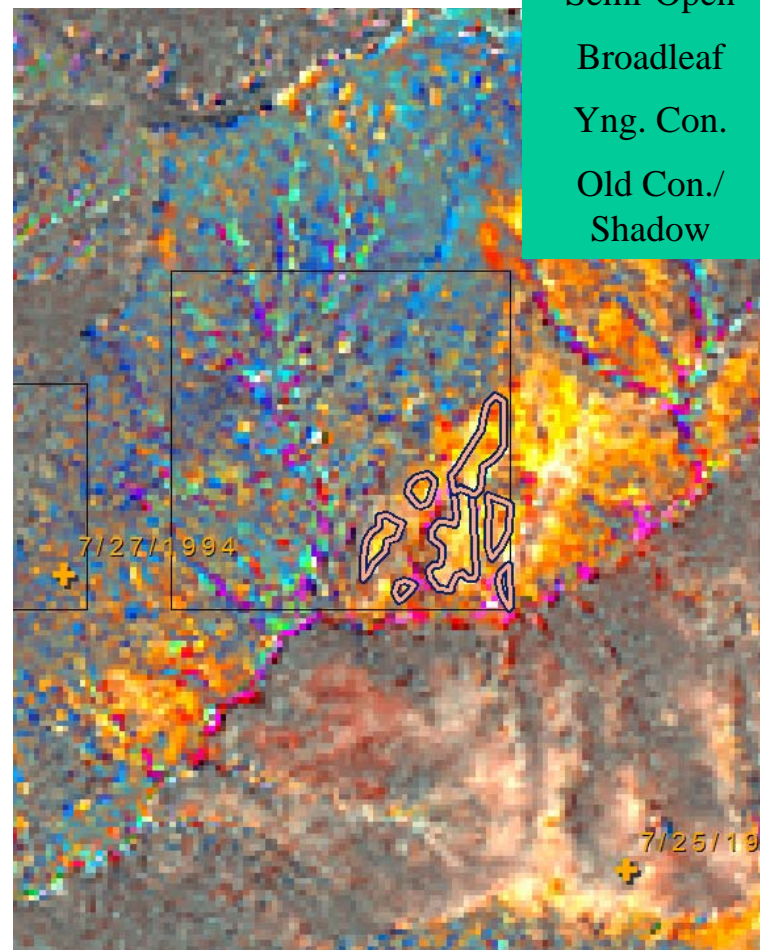
|                     |      |
|---------------------|------|
| Rock                | -114 |
| Rock                | -192 |
| Semi-Open           | 307  |
| Broadleaf           | 371  |
| Yng. Con.           | 457  |
| Old Con./<br>Shadow | 264  |



Vector Image  
R: Rock G: Brdlf B: Yng Con.

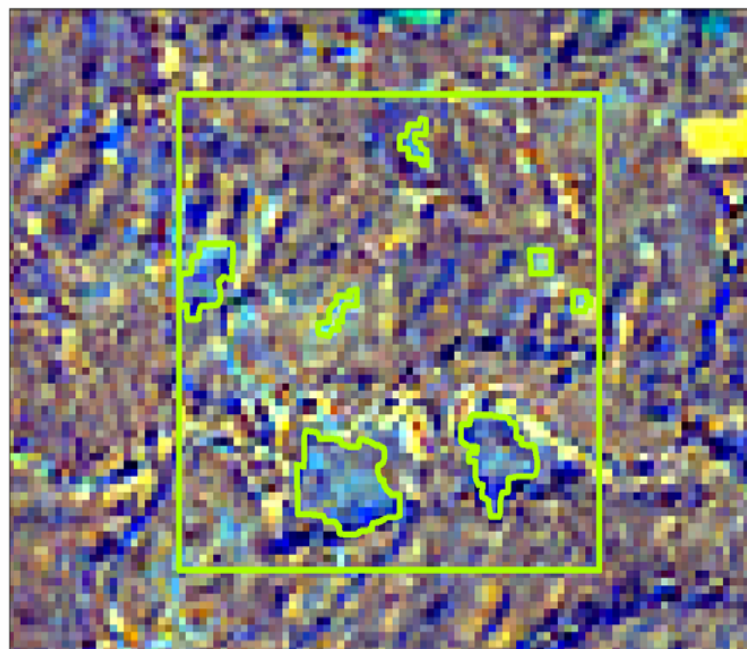
## Vector Scores

|                     |      |
|---------------------|------|
| Rock                | 446  |
| Rock                | 374  |
| Semi-Open           | 450  |
| Broadleaf           | 346  |
| Yng. Con.           | 57   |
| Old Con./<br>Shadow | -360 |



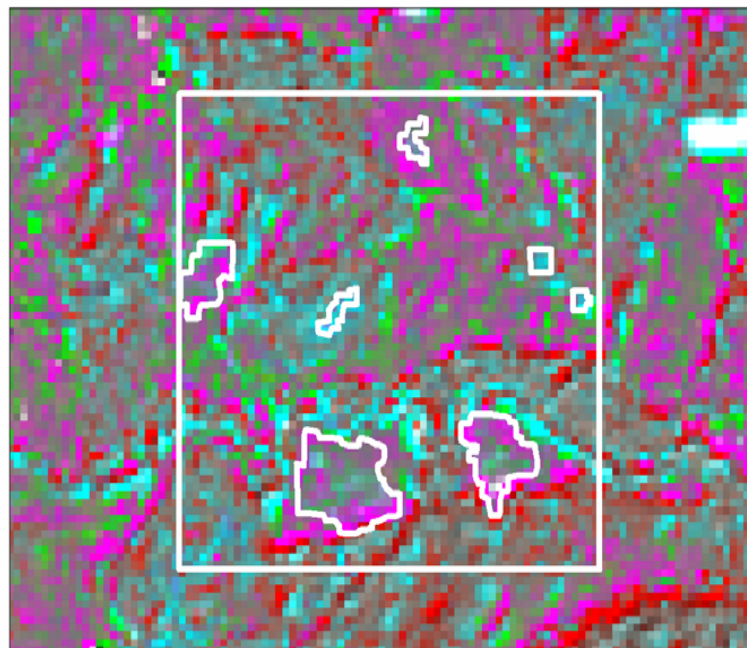
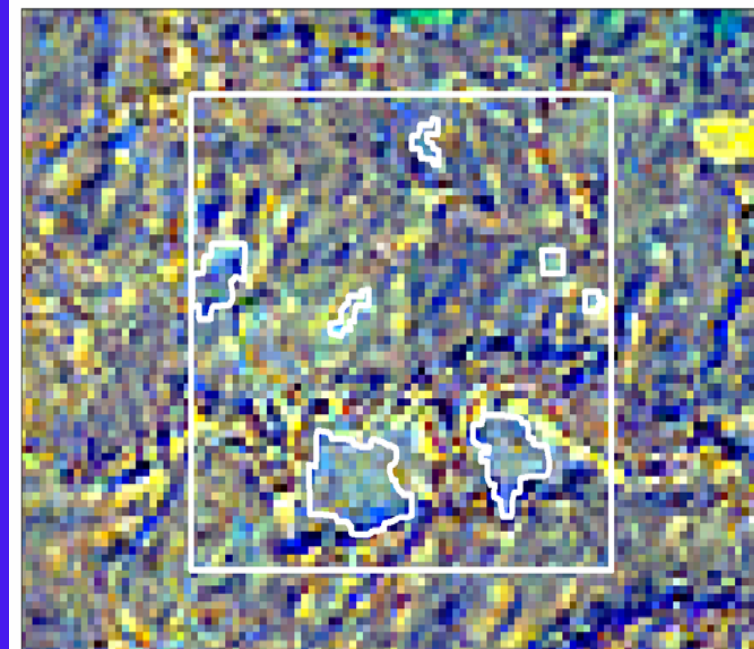
Vector Image  
R: Rock G: Brdlf B: Yng Con.

# Regrowth at OLYM



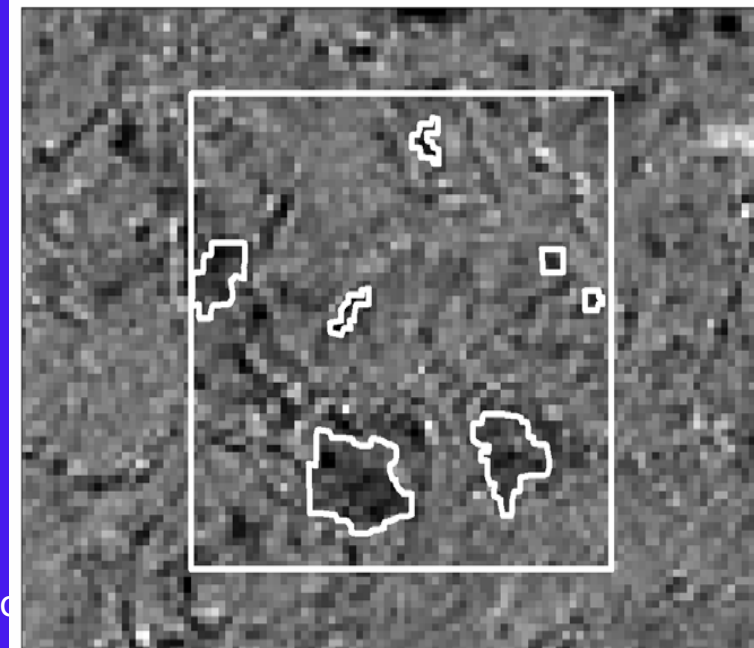
CV

Diff  
Image



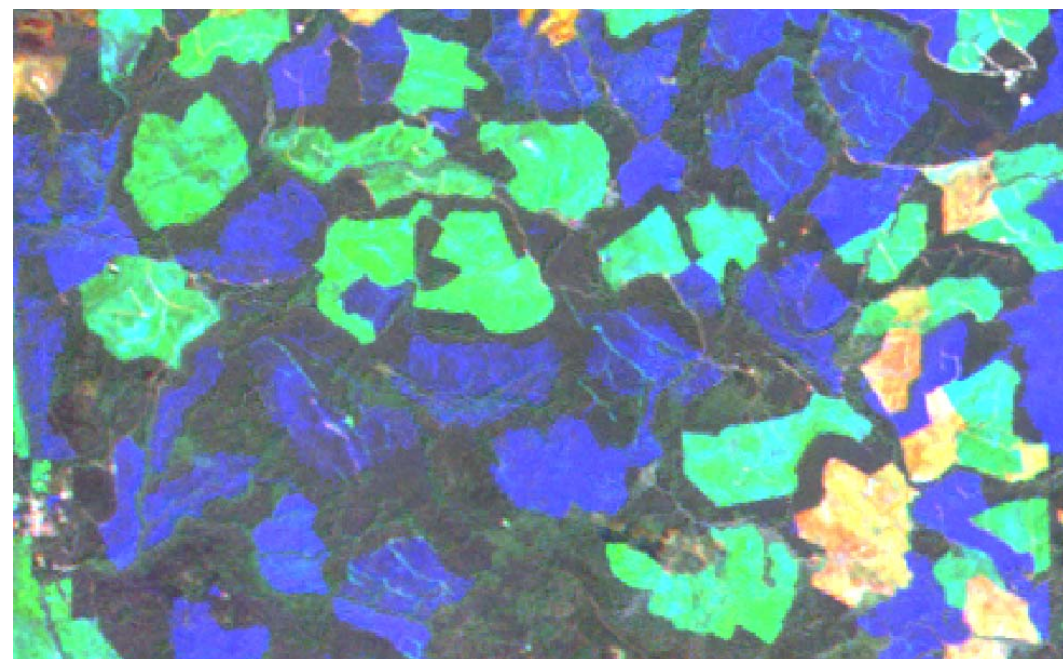
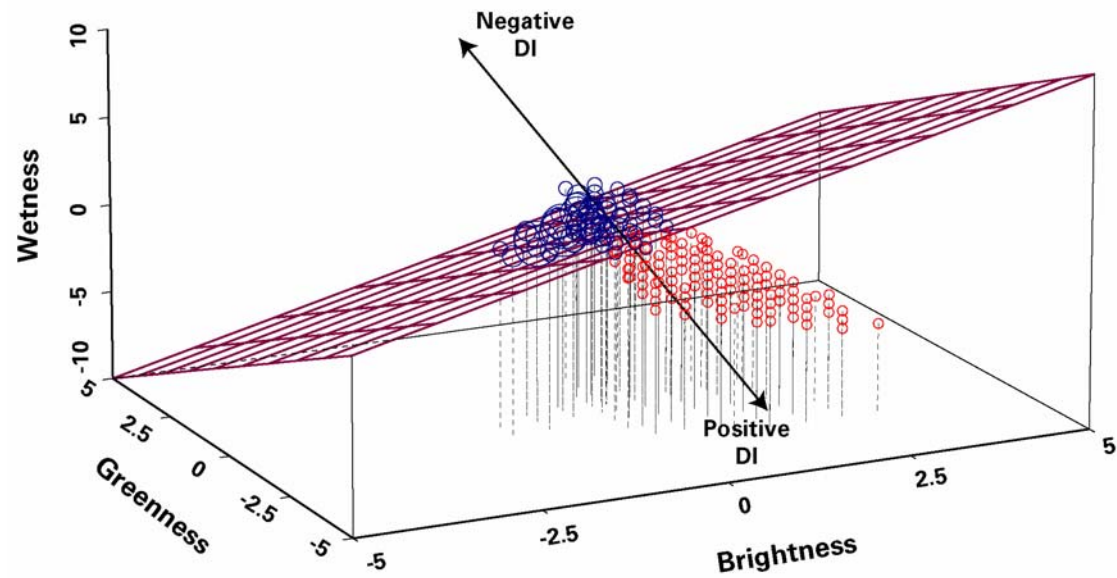
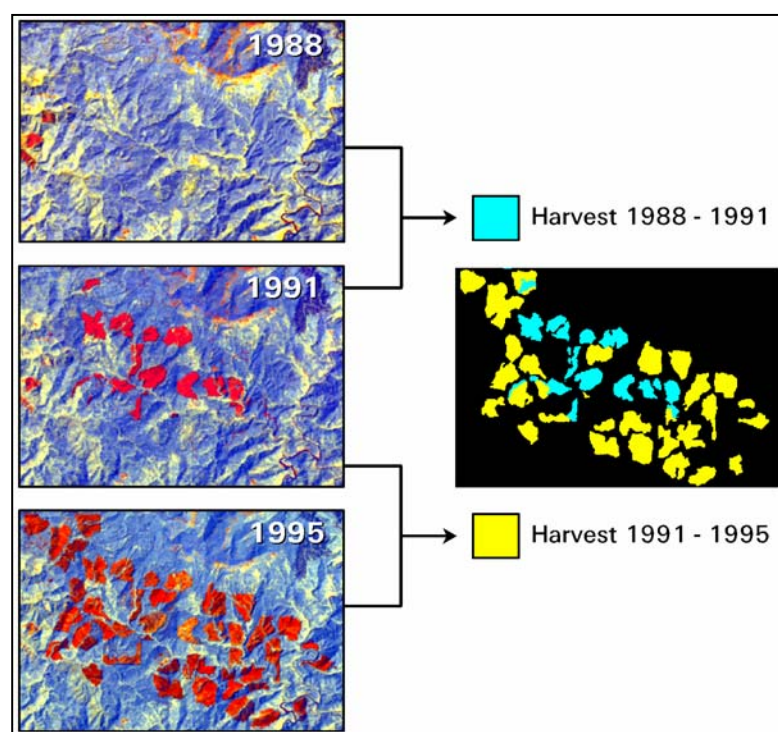
DCV

DI

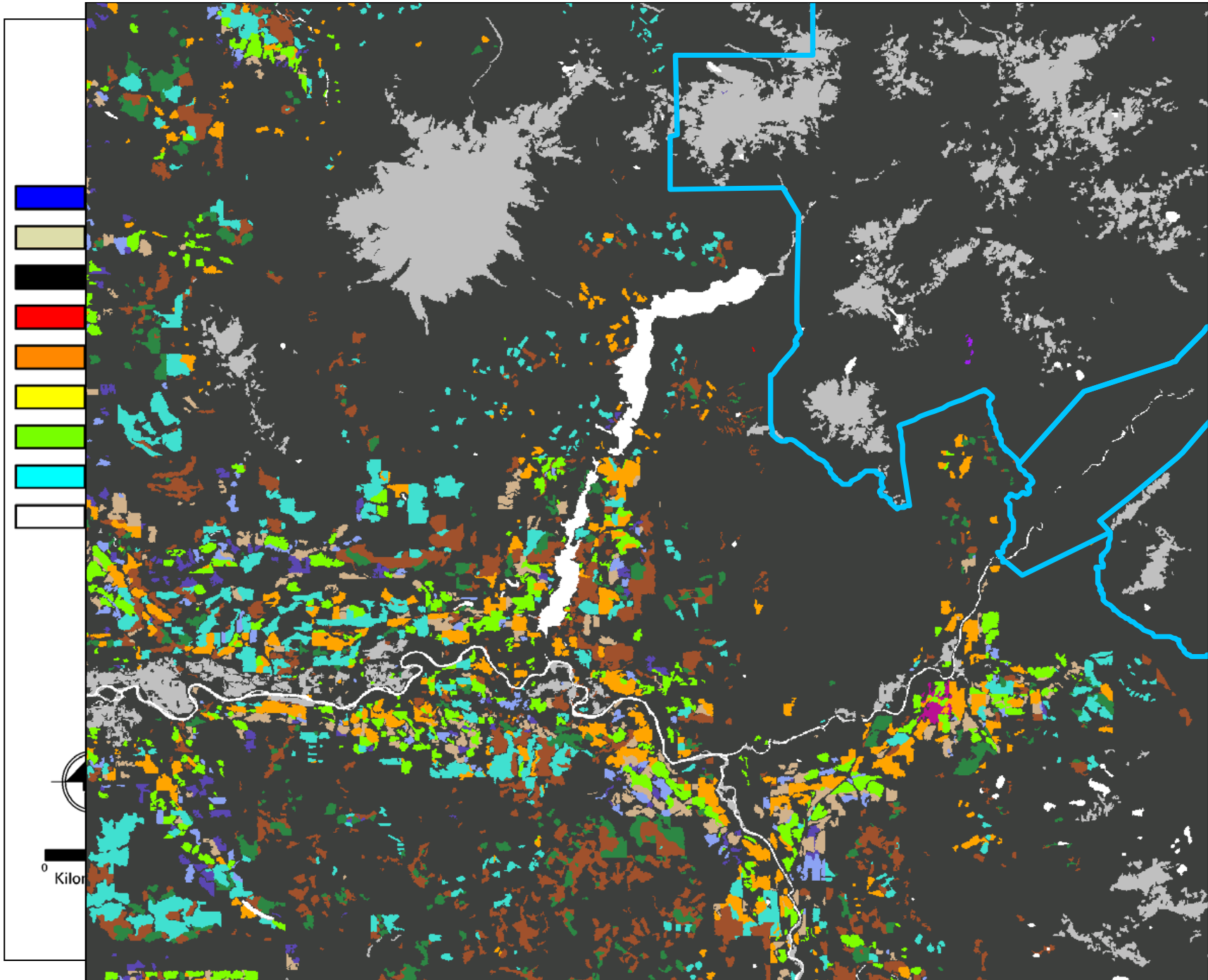


/ Disturbance and Recd

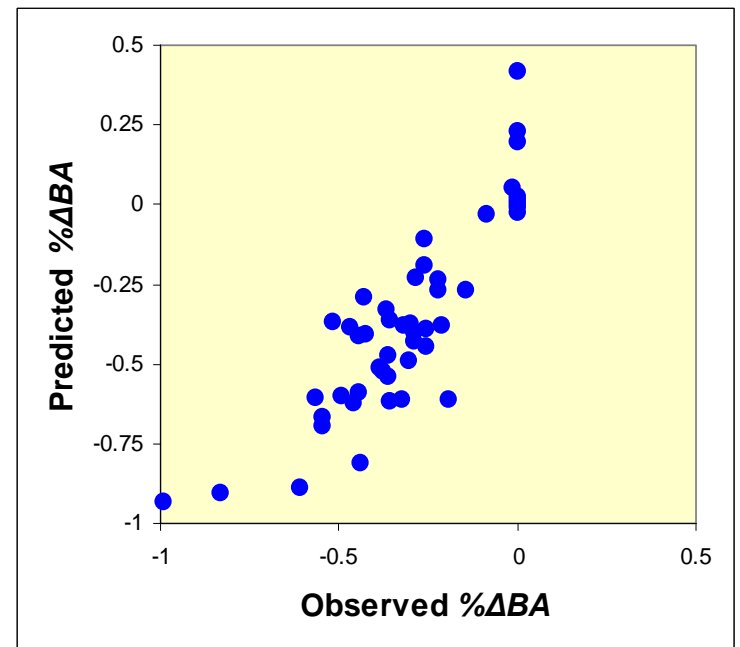
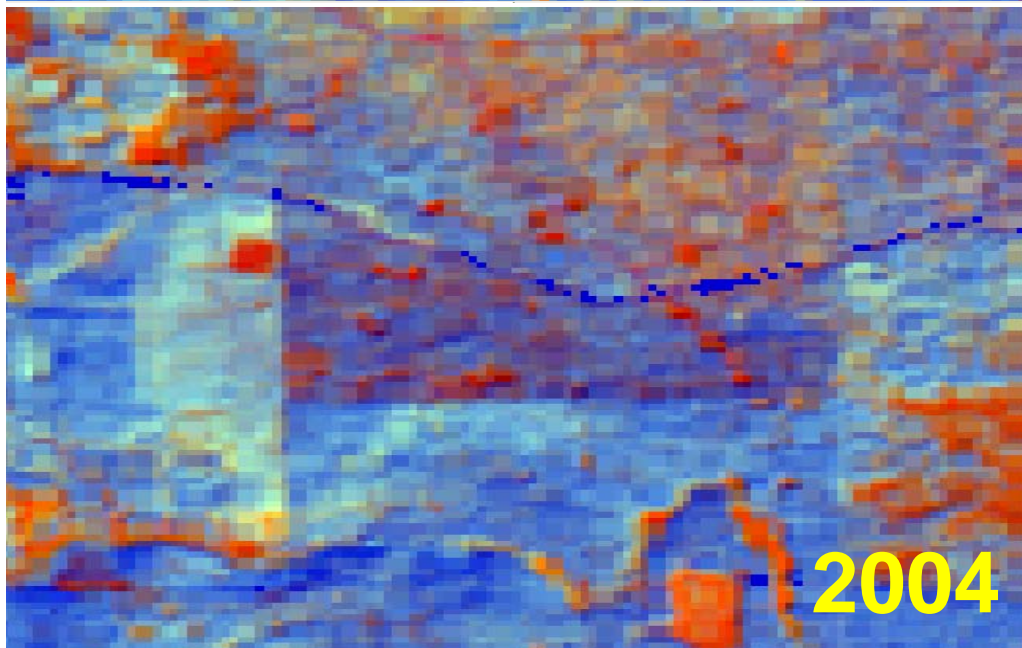
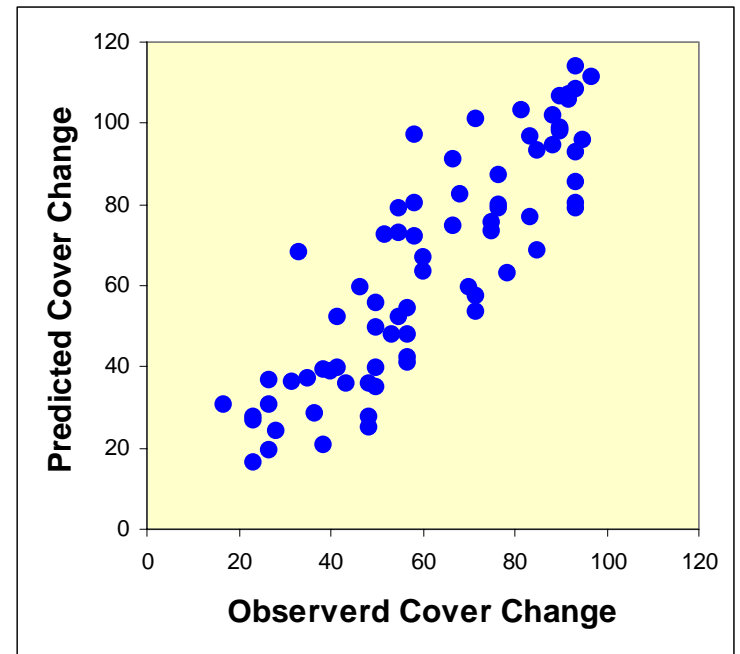
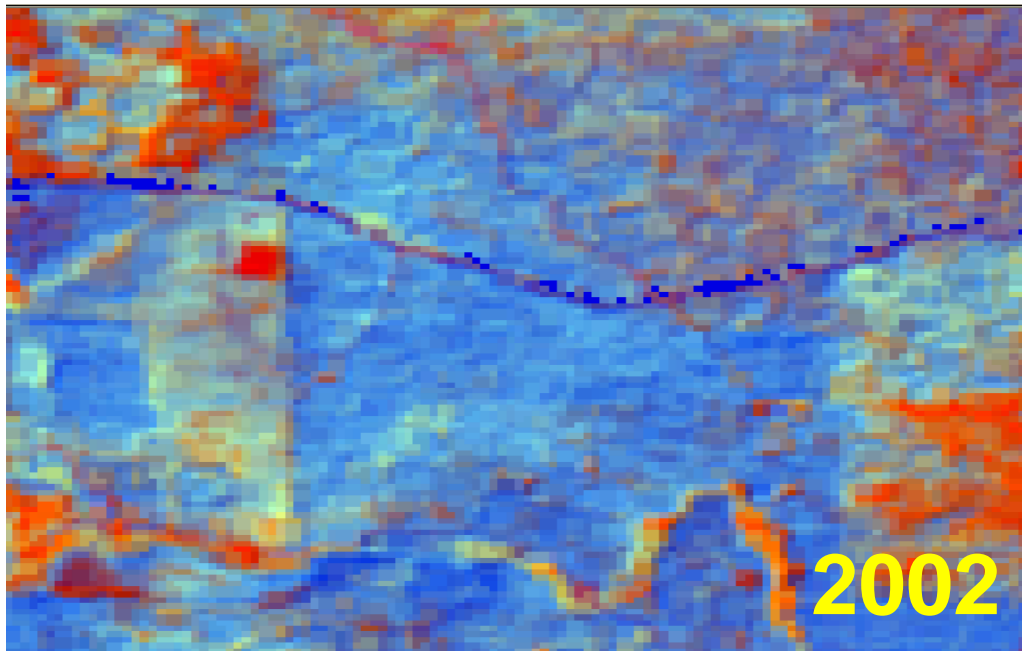


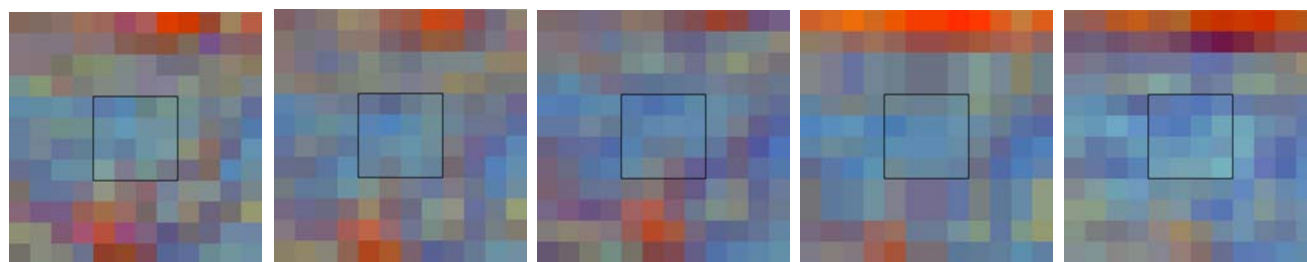


Red (date 1)  
Green (date 2)  
Blue (date 3)

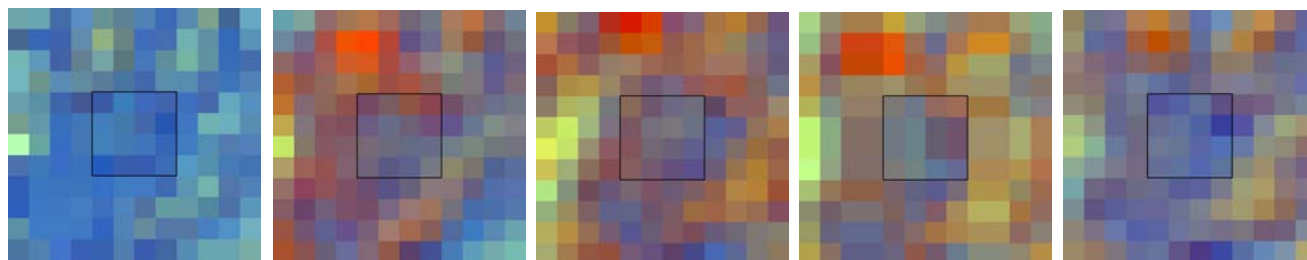




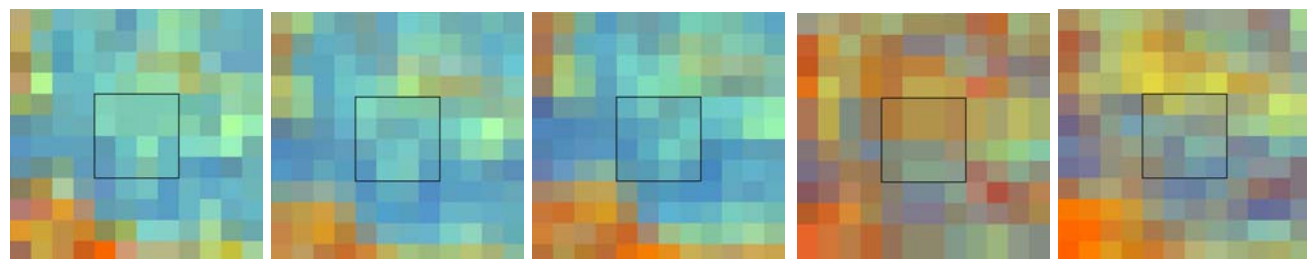




Unthinned



1996-1998



1998-2000

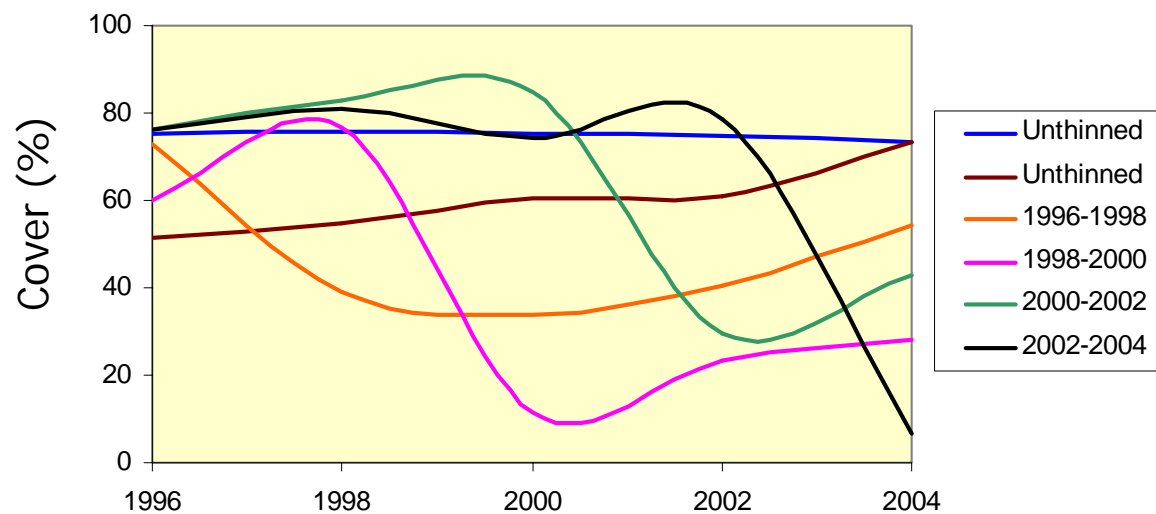
1996

1998

2000

2002

2004

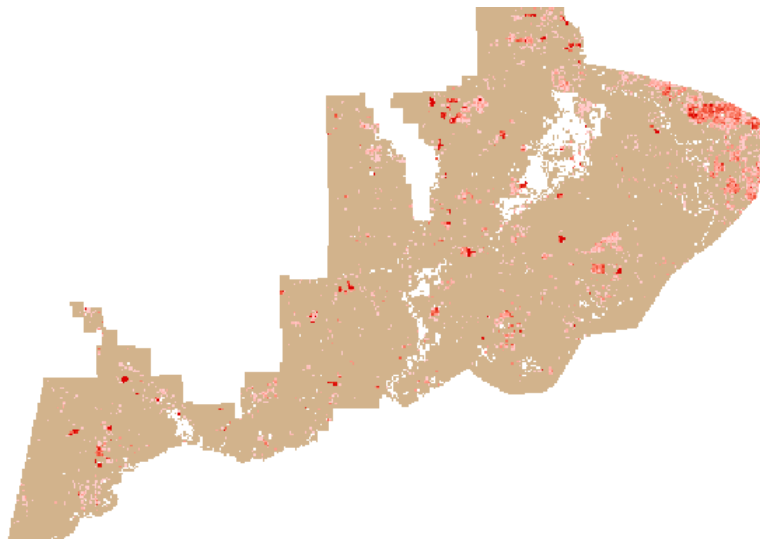


# Percent Removal

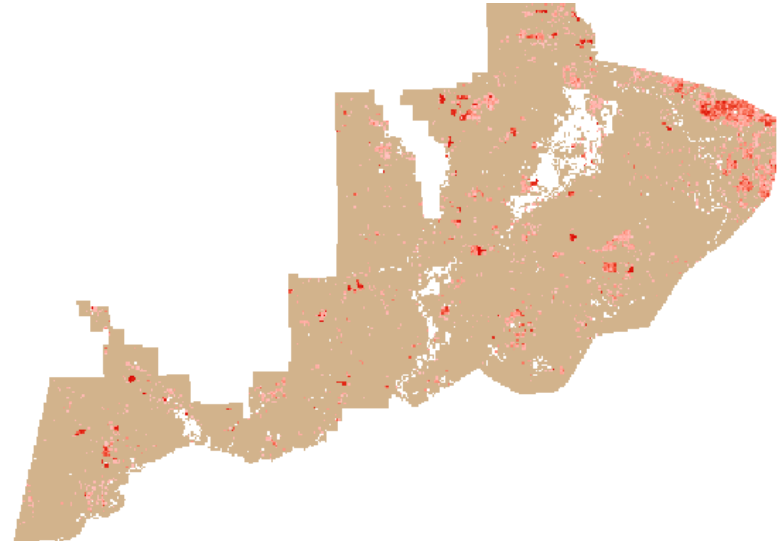
0



100



**Cover change  
1996-1998**

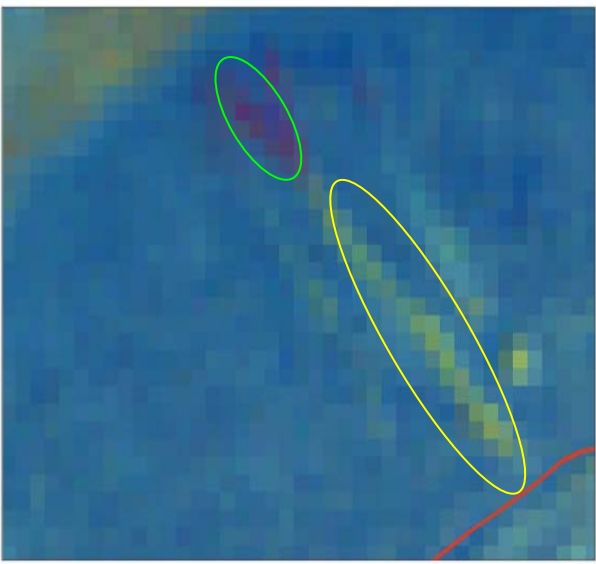


**Basal area change  
1996-1998**

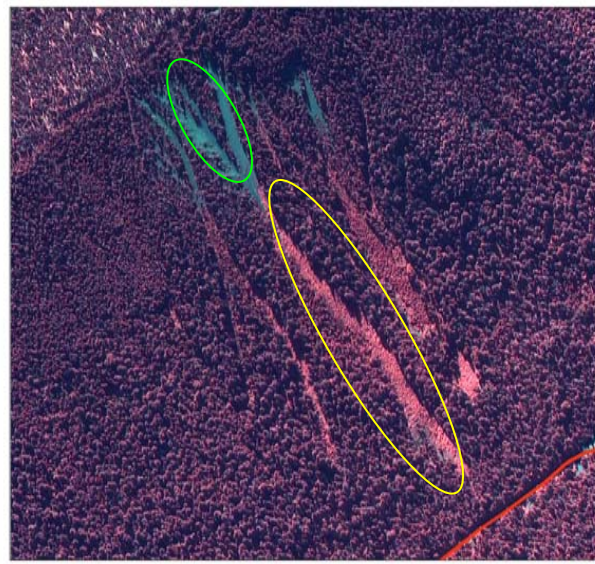


# Validation from viewpoints (MORA, NOCA)

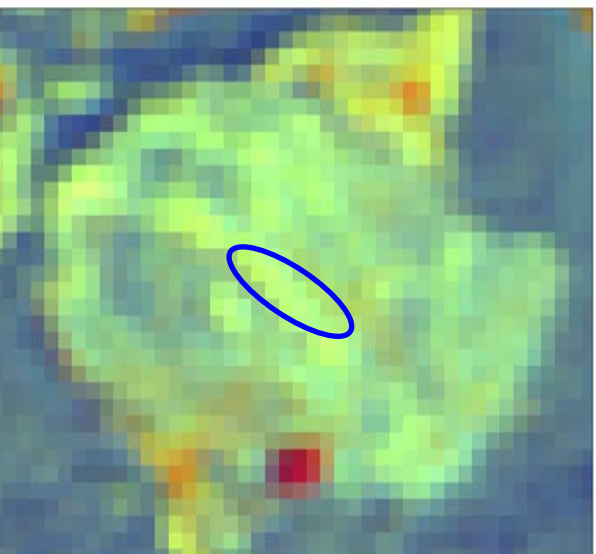
Tasseled cap Landsat image



IKONOS color IR image



2004 oblique photo





Garmin GPS connected to PDA

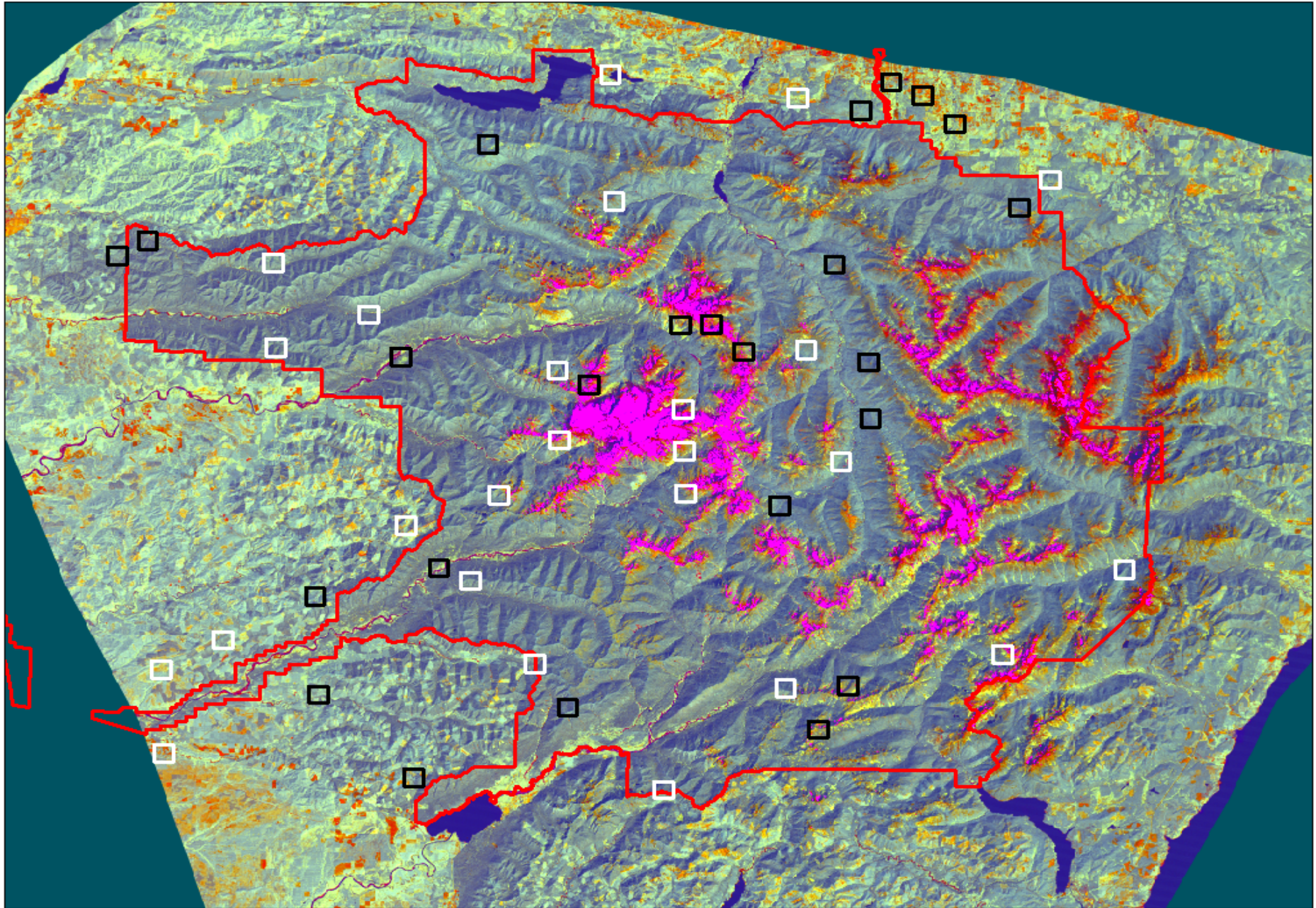


Dell Axim 5 running ArcPad





Testing in white, training in black

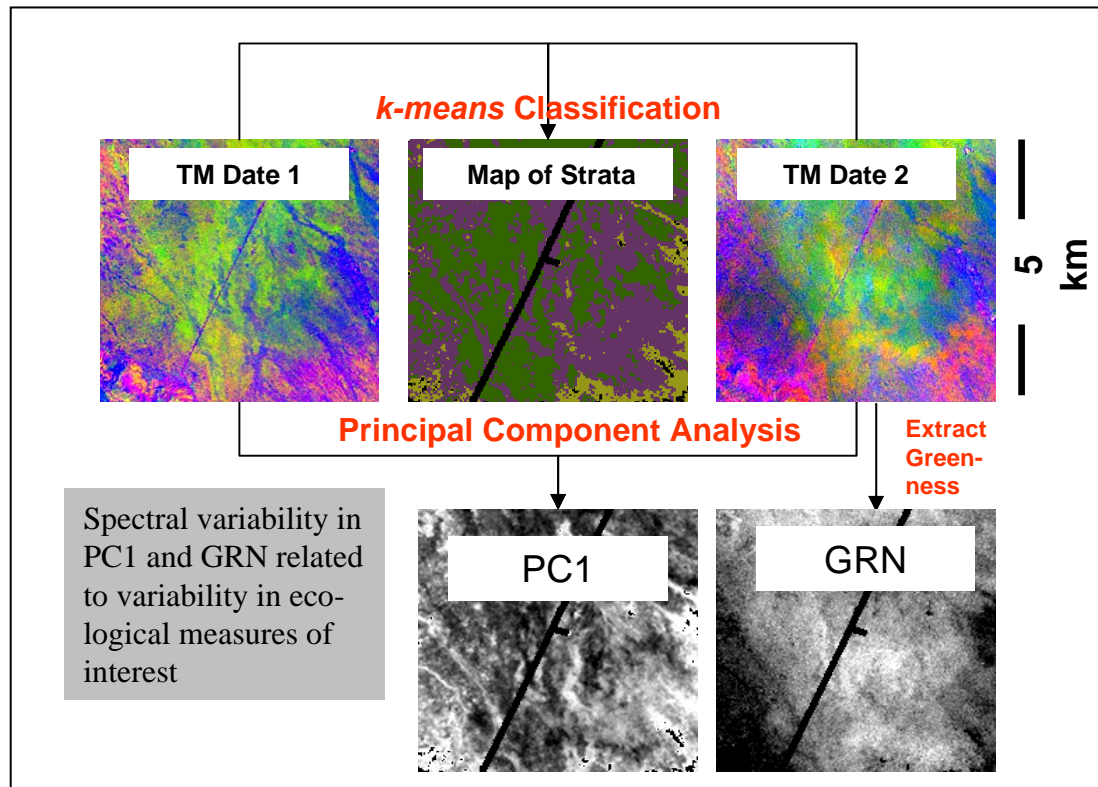




Sampling to meet three competing goals:

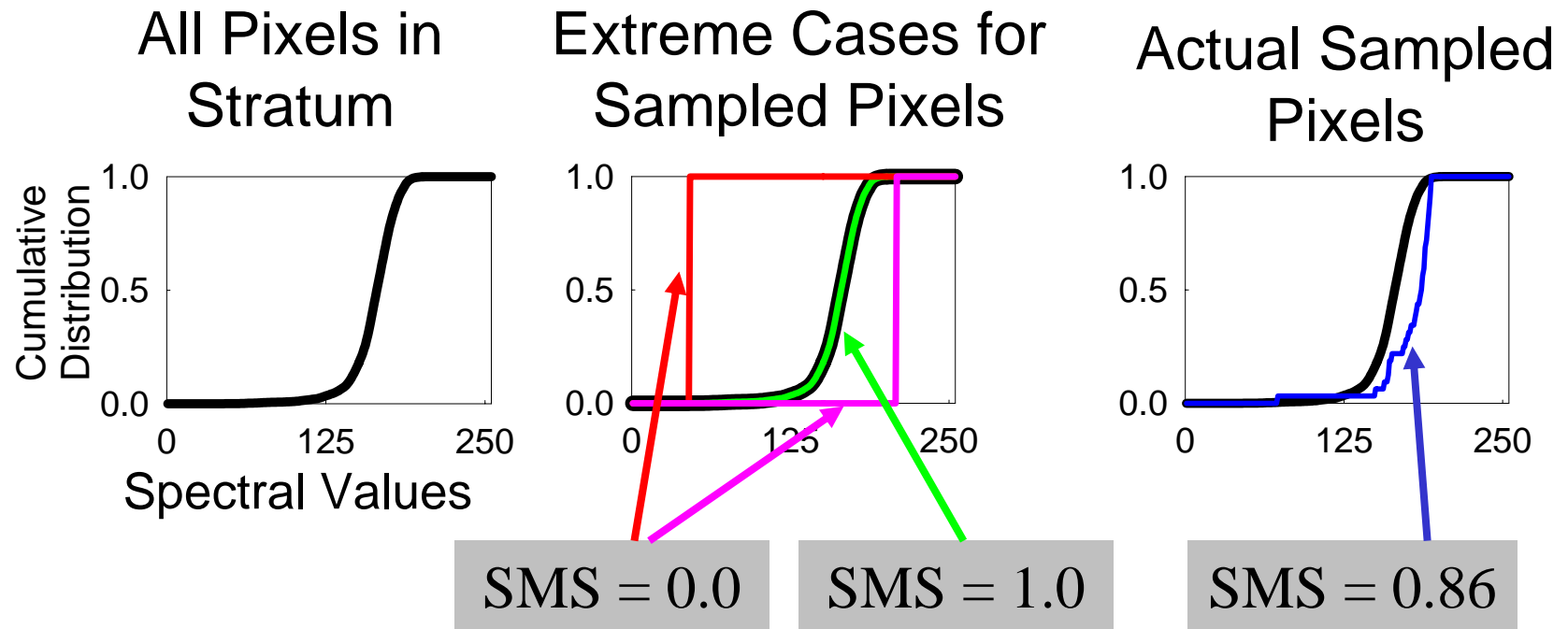
1. **SUFFICIENCY**- Capture variability over landscape
2. **EFFICIENCY**- Minimize field travel costs
3. **INDEPENDENCE**- Avoid pseudoreplication

### Assemble Spatial Data

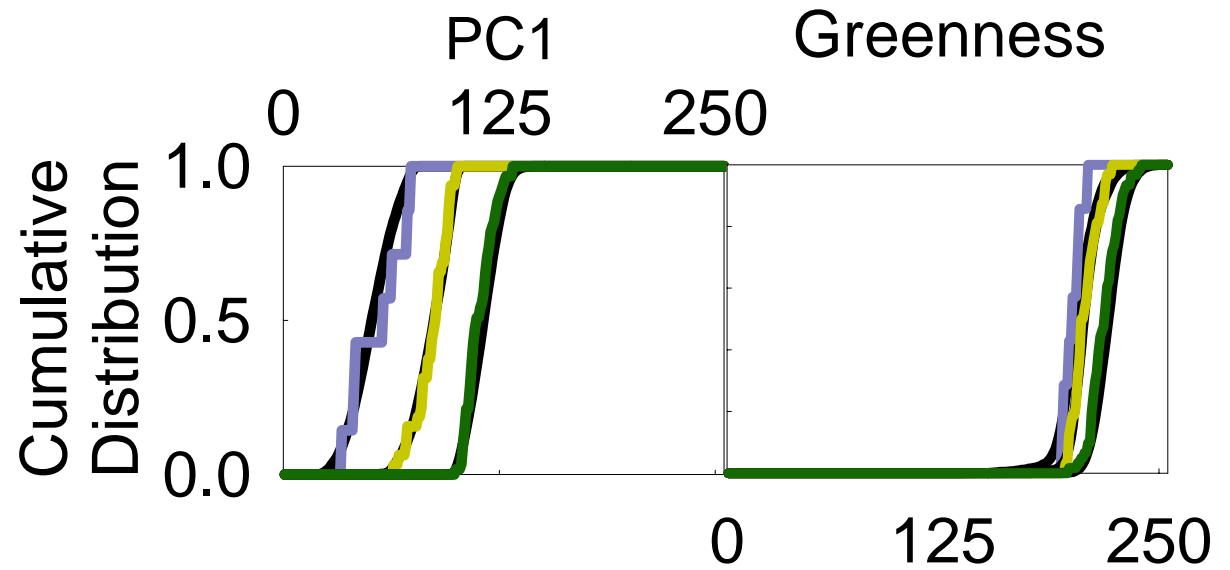
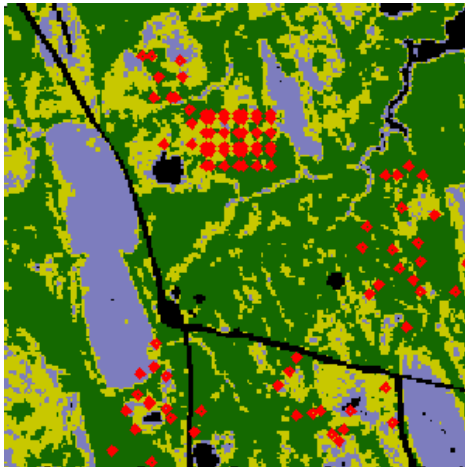
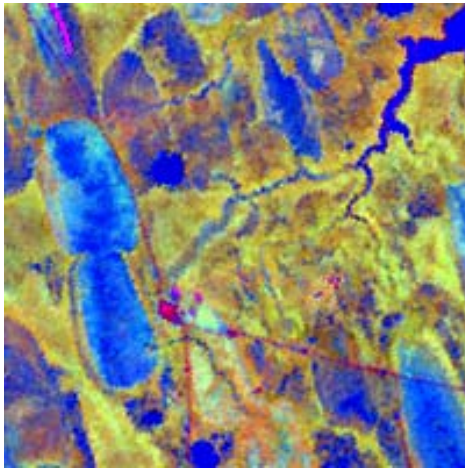


# Score Spectral Match

- Compare cumulative distribution of **sampled pixels** with that of **all pixels** within stratum
- Scale **spectral match score (SMS)** from 0 to 1







|           | Class 1 | Class 2 | Class 3 |
|-----------|---------|---------|---------|
| PC1       | 0.86    | 0.97    | 0.92    |
| Greenness | 0.92    | 0.98    | 0.94    |

# Summary

- Parks need to monitor a variety of cover changes occurring over multiple scales
- Compromises are necessary as no single tool is suited to all problems and budgets are limited
- Important to be guided by the problem and find the tools needed, rather than force a given tool to solve problem it is not good at solving
- Transformations/indices of remote sensing data are numerous; if SWIR is available use it
- Monitoring changes in cover properties is accomplished by monitoring changes in original or transformed data space using any of a vast number of strategies
- Reference data are key to effective use of remote sensing and for characterizing uncertainty in remotely sensed products—for this a thoughtful sampling scheme may be advantageous